

Utilizing of the Lymphocyte/CRP Ratio as a Predictor of Ischemia in Acute Incarcerated Hernias

Akut İnkarşere Hernilerde Lenfosit/CRP Oranının İskemi Öngörücüsü Olarak Kullanılması

İD Tufan Gümüş, İD Recep Temel, İD Ebubekir Korucuk, İD Sarp Tunalı, İD Yiğit Türk, İD Berk Göktepe, İD Muhtar Sinan Ersin

Ege University Faculty of Medicine, Department of General Surgery, İzmir, Türkiye

Cite as: Gümüş T, Temel R, Korucuk E, et al. Utilizing of the Lymphocyte/CRP ratio as a predictor of ischemia in acute incarcerated hernias. Anatol J Gen Med Res. 2025;35(2):170-7

Abstract

Objective: This study aimed to evaluate the lymphocyte-to-[C-reactive protein (CRP)] (LCR) ratio as a potential biomarker for predicting ischemia in patients with acute incarcerated hernias (AIH) and its role in determining the need for bowel resection.

Methods: A retrospective analysis was conducted on 132 patients with AIH who presented to the Ege University Department of Emergency between January 2020 and January 2022. Clinical data, laboratory values (including leukocyte and lymphocyte counts, CRP, and LCR), and imaging results were collected. Patients were divided into two groups: those who underwent bowel resection (n=37) and those who did not (n=95). Relevant parameters were compared between the groups, and receiver operating characteristic (ROC) analysis was performed to assess the predictive value of LCR for ischemia.

Results: The study found that LCR was significantly lower in patients who required bowel resection ($p<0.001$). The ROC curve analysis showed that LCR had an area under the curve of 70.1%, with a sensitivity of 91.6% and specificity of 78.4%. A cut-off value of 0.0409 was identified, with patients above this threshold showing a lower likelihood of requiring resection ($p<0.001$). Mortality was also higher in the low LCR group ($p<0.001$).

Conclusion: The LCR was found to be a significant and reliable predictor of ischemia in AIH. LCR can be used as a simple, cost-effective biomarker to assist in clinical decision-making, particularly in predicting the need for resection and improving patient outcomes. Further studies are recommended to validate these findings.

Keywords: Incarcerated hernia, lymphocyte, C-reactive protein

Öz

Amaç: Bu çalışmada; akut inkarsere herni (AİH) hastalarında iskemiye öngörmeye potansiyel bir biyobelirteç olarak lenfosit/[C-reaktif protein (CRP)] (LCO) oranını değerlendirmek ve barsak rezeksiyonu ihtiyacını belirlemedeki rolü amaçlanmıştır.

Yöntem: Ocak 2020 ile Ocak 2022 tarihleri arasında Ege Üniversitesi Acil Servisi'ne başvuran 132 AİH hastası üzerinde retrospektif bir analiz gerçekleştirilmiştir. Klinik veriler, laboratuvar değerleri (lökosit ve lenfosit sayıları, CRP ve LCO dahil) ve görüntüleme sonuçları değerlendirildi. Hastalar, barsak rezeksiyonu yapılan (n=37) ve yapılmayan (n=95) olmak üzere iki gruba ayrıldı. Gruplar arasında ilgili parametreler karşılaştırıldı ve LCO'nun iskemi için prediktif değerini değerlendirmek için alıcı çalışma karakteristiği (ROC) analizi yapıldı.



Address for Correspondence/Yazışma Adresi: Tufan Gümüş MD, Ege University Faculty of Medicine, Department of General Surgery, İzmir, Türkiye

E-mail: dr.tufan.gumus@gmail.com

ORCID ID: orcid.org/0000-0003-1861-8282

*Our study was presented as a poster in 46th European Hernia Society Annual Conference in 2024.

Received/Geliş tarihi: 29.04.2025

Accepted/Kabul tarihi: 27.05.2025

Published date/Yayınlanma tarihi: 11.08.2025



Copyright© 2025 The Author. Published by Galenos Publishing House on behalf of University of Health Sciences Turkey, İzmir Tepecik Education and Research Hospital. This is an open access article under the Creative Commons AttributionNonCommercial 4.0 International (CC BY-NC 4.0) License.

Öz

Bulgular: Çalışma, barsak rezeksiyonu gerektiren hastalarda LCO'nun anlamlı olarak daha düşük olduğunu buldu ($p<0,001$). ROC eğrisi analizi, LCO'nun eği altındaki alanın %70,1 olduğunu, duyarlılığının %91,6 ve özgüllüğünün %78,4 olduğunu gösterdi. 0,0409 kesme değeri belirlendi ve bu eşiğin üzerindeki hastaların rezeksiyon gerekliliği olasılığı daha düşük bulundu ($p<0,001$). Mortalite de LCO düşük olan grupta daha yüksekti ($p<0,001$).

Sonuç: LCO, AIH'lerde iskeminin önemli ve güvenilir bir belirleyicisi olarak bulunmuştur. LCO, özellikle rezeksiyon ihtiyacını tahmin etmek ve hasta sonuçlarını iyileştirmek için klinik karar verme sürecine yardımcı olacak basit ve uygulanabilir bir biyomarker olarak kullanılabilir. Bu bulguları doğrulamak için daha fazla çalışmaya ihtiyaç vardır.

Anahtar Kelimeler: İnkarsere herni, lenfosit, C-reaktif protein

Introduction

An acute incarcerated hernia (AIH) occurs when the contents of the hernia sac cannot be reduced back into the abdominal cavity. In contrast, a strangulated hernia involves compromised blood flow to the herniated intestinal segment due to incarceration, representing a serious complication associated with high morbidity and mortality that often necessitates emergency surgery⁽¹⁾. It is well established that in the emergency repair of incarcerated and strangulated hernias, postoperative mortality, the need for reoperation, and the rate of readmission can increase by up to 15-fold compared to elective hernia surgery⁽²⁾.

Although emergency surgery plays a critical role in the treatment of AIH, it may not always be immediately feasible due to associated risks and limited surgical availability⁽³⁾. In such cases, manual reduction by gently repositioning the herniated tissues back into the abdominal cavity can serve as a temporary solution, potentially delaying the need for surgery from days to even months⁽⁴⁾. Following successful reduction, patients can be monitored for signs of recurrence or ischemia and subsequently scheduled for elective surgery, thereby reducing the risk of high morbidity and mortality.

It is known that postoperative complications are also more common in patients who develop strangulation and need resection^(5,6). Therefore, development of ischemia is of critical importance in terms of complications both in patients scheduled for elective surgery following reduction and in patients who will undergo emergency surgery.

With the widespread use of laboratory tests, proportional parameters have recently become popular in the diagnosis of diseases and prediction of prognosis⁽⁷⁾. Many studies and meta-analyses have been published showing that biomarkers such as neutrophil/lymphocyte ratio (NLR), neutrophil/C-reactive protein (CRP) ratio (NCR), lymphocyte/CRP ratio (LCR) -which are obtained from parameters

including leukocytes, neutrophils, lymphocytes, platelets, CRP, and albumin for the evaluation of inflammation- can be used in the diagnosis and follow-up of acute and chronic inflammatory pathologies, sepsis, and malignancies^(8,9).

In our study, we aimed to examine the patient's clinical and laboratory parameters in order to evaluate and predict the presence of ischemia, which plays a critical role in the decision-making process in the treatment of AIH.

Materials and Methods

Study Design

Patients presenting to the Ege University Department of Emergency with AIH and evaluated by our team were retrospectively analyzed. Demographic data, blood counts, and computed tomography findings were reviewed. Patients were categorized into two groups: those who underwent bowel resection and those who did not. Bowel ischemia was evaluated intraoperatively and confirmed by histopathological examination in the resection group. Relevant parameters were compared between the groups, and factors associated with the need for resection were identified. The aim was to determine potential predictive markers of ischemia.

Patient Selection

Patients who presented to the emergency department with AIH between January 2020 and January 2022, and were evaluated by our team, were included in the study. Inclusion criteria were: age over 18 years, diagnosis of AIH (including incisional, umbilical, inguinal, or femoral hernias), availability of complete clinical and laboratory data, and acceptance of hospital admission from the emergency department to our surgical clinic. Patients who underwent successful reduction in the emergency department and were not admitted for hospitalization were excluded from the study.

Data Collection

Demographic data, blood counts, and imaging methods of the patients were collected retrospectively through the electronic patient file. Demographic data, complete blood counts, presence of resection (if any), known history of hernia, lactate, lactate dehydrogenase (LDH), CRP values, duration of admission to the emergency department and evaluation in the emergency department, duration of hospitalization, and mortality were collected electronically. Statistical analyses were performed. The value of LCR was calculated as $[1.000 \times \text{lymphocyte count} (\times 10^9 \text{ cells/L})]/[\text{CRP} (\text{mg/L})]$.

Statistical Analysis

SPSS v29.0 (IBM-Chicago, USA) was used to analyze the data, and the normality of continuous data was evaluated by Shapiro-Wilk and Kolmogorov-Smirnov tests. Student's t-test was used for univariate pairwise group analysis of continuous data showing normal distribution, and Mann-Whitney U test was used for univariate pairwise group analysis of continuous data not showing normal distribution. In the analysis of categorical variables, chi-square and Pearson chi-square tests were used according to the table width, and Fisher's exact test was applied when necessary. The ROC curve was utilized as a predictive test, and the Youden index was used to determine the cut-off value.

Ethics

Our study was evaluated by Ege University Medical Research Ethics Committee and approved (decision no: 24-8T/41, date: 22.08.2024).

Results

A total of 132 patients fulfilling the specified criteria were included in our study. Age was not normally distributed, and the median age was 69 years (interquartile range: 64.87-69.87 years). Seventy (53.0%) of the patients were male and 62 (47.0%) were female. Incisional hernia was present in 47 patients (35.6%), umbilical hernia in 19 patients (14.4%), inguinal hernia in 56 patients (42.4%), and femoral hernia in 10 patients (7.6%). Six patients (4.5%) were followed up after reduction and referred to elective surgery, while 126 patients (95.4%) underwent emergency surgery.

Among the patients who underwent emergency surgery, 37 (29.3%) required bowel resection, while 89 (70.7%) did not. Of those who underwent resection, 29 patients (78.4%) had small bowel resection, and 8 patients (21.6%) underwent

colon resection. Relevant parameters are summarized in Table 1 and Figure 1.

Six patients who were managed conservatively after successful reduction were included in the non-resection group, as they did not require surgical resection during their hospitalization. Thus, patients were divided into two groups: resection (n=37) and non-resection (n=95). The following variables were compared between the groups: age, sex, presence of a known hernia, recurrent hernia status, time from symptom onset to emergency department presentation, time to surgical evaluation, hernia type at presentation, imaging modalities used, the American Society of Anesthesiology (ASA) scores, leukocyte and lymphocyte counts, lactate, LDH, CRP, LCR, length of hospital stay, and mortality. (Related parameters and p-values are summarized in Table 2). The female-to-male ratio differed significantly between the non-resection (40/60%) and resection (35.5/64.5%) groups (p=0.010).

The ASA 1 rate was 32.6% in the non-resection group, compared to 16.2% in the resection group. ASA scores were significantly higher in the resection group, with the difference reaching statistical significance (p=0.020).

Table 1. Demographic data of the patients		
Parameters	Median/number	95% CI/percent
Age (years)	69	[64.87-69.87]
Gender		
Male	70	53.0%
Woman	62	47.0%
Hernia type		
Incisional	47	35.0%
Umbilical	19	14.0%
Inguinal	56	42.2%
Femoral	10	7.6%
Known presence of hernia	36	27.3%
Presence of recurrent hernia	22	16.7%
USG	35	26.5%
CT	60	45.5%
CT+ USG	37	28.0%
ASA score		
1	37	28.0%
2	65	49.2%
3	30	22.7%
ASA: American Society of Anesthesiology, CI: Confidence interval, USG: Ultrasonography, CT: Computed tomography		

When the lymphocyte count was evaluated, the median value was $1.45 \times 10^3/\mu\text{L}$ in the non-resection group, compared to $1.07 \times 10^3/\mu\text{L}$ in the resection group. The difference was statistically significant ($p=0.001$).

CRP levels were compared between the two groups; the median value was 10.32 U/L in the non-resection group and 26.59 U/L in the resection group, with a statistically significant difference ($p=0.006$). The median LCR value was 0.130 in the non-resection group, compared to 0.027 in the resection group, a difference that was statistically significant ($p<0.001$). Regarding the duration of hospitalization, a significant difference was observed between the groups ($p=0.005$), with a median stay of 2.0 days in the non-resection group and 4.0 days in the resection group.

During hospitalization, mortality occurred in 8 patients (8.4%) in the non-resection group and in 9 patients (24.8%) in the resection group, with the difference being statistically significant ($p=0.014$).

There was no statistically significant difference between the groups in the other available parameters and the relevant values are summarized in Table 2.

LCR was found to be a significant parameter for predicting ischemia, prompting the use of a receiver operating characteristic (ROC) curve to evaluate its predictive value, given its simplicity, effectiveness, and low cost. The area under the curve was 70.1%, which was statistically significant ($p<0.001$, 95% confidence interval: 0.59-0.79) (Figure 2).

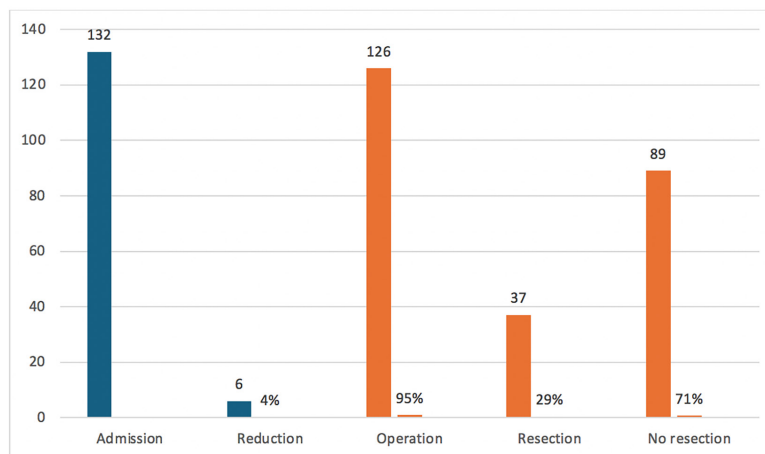


Figure 1. Distribution of operations and resections

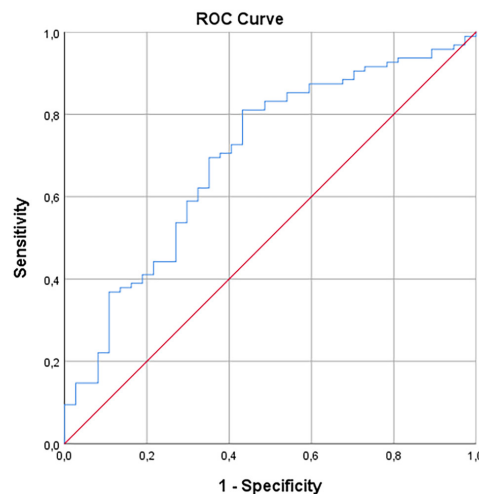


Figure 2. ROC curve for LCR

ROC: Receiver operating characteristic, LCR: Lymphocyte/C-reactive protein ratio

The test demonstrated a sensitivity of 91.6%, specificity of 78.4%, positive predictive value of 91.6%, and negative predictive value of 78.4%.

After obtaining statistical significance in the ROC analysis, the Youden index was used to determine the cut-off value, which was found to be 0.0409. Based on this threshold, patients were divided into two groups: those with LCR higher than 0.0409 and those with LCR lower than 0.0409. A total of 39 patients (29.5%) were in the low LCR group, and 93 patients (70.5%) were in the high LCR group. Among the low

LCR group, 46.2% did not require resection, whereas 82.8% of the high LCR group also avoided it, with the difference being statistically significant ($p<0.001$). Mortality was 28.2% in the low LCR group and 6.5% in the high LCR group, being with the difference with the difference also being statistically significant ($p<0.001$). Relevant parameters are summarized in Table 3 and Figure 3.

Discussion

In our study, we demonstrated that laboratory parameters can be used simply and effectively to predict the need for

Table 2. Comparison of parameters between groups

Parameter	No resection	Resection	p
Age (years)	69 (63.75-69.74)	71 (64.25-73.69)	0.383
Gender			
Male	57 (60%)	13 (35.1%)	0.010
Female	38 (40%)	24 (64.9%)	
Known presence of hernia	26 (27.4%)	10 (27.0%)	0.968
Presence of recurrent hernia	17 (17.9%)	5 (13.5%)	0.544
Hernia type	34 (35.8%)	14 (37.8%)	0.603
Incisional	13 (13.7%)	5 (13.5%)	
Umbilical	42 (44.2%)	14 (37.8%)	
Inguinal femoral	6 (6.3%)	4 (10.8%)	
Time between symptom and emergency department admission (days)	2.00 (2.52-4.11)	2.00 (2.15-3.79)	0.948
Duration of evaluation in the emergency department (hours)	7.00 (7.21-9.53)	7.00 (5.49-11.27)	0.322
Imaging			
USG	24 (25.3%)	11 (29.7%)	0.769
CT	45 (47.5%)	15 (40.6%)	
CT+USG	26 (27.3%)	11 (29.7%)	
ASA score			
1	31 (32.6%)	6 (16.2%)	0.020
2	48 (50.6%)	17 (45.9%)	
3	16 (16.8%)	14 (37.9%)	
Leukocyte count ($10^3/\mu\text{L}$)	11.99 (10.97-12.94)	10.18 (10.22-15.37)	0.669
Lymphocyte count ($10^3/\mu\text{L}$)	1.45 (1.46-2.12)	1.07 (0.85-1.30)	0.001
Lactate (mmol/L)	3.60 (4.56-7.38)	5.00 (5.70-10.09)	0.063
LDH (U/L)	211.0 (213.17-243.99)	234.0 (225.00-279.59)	0.104
CRP (mg/L)	10.32 (20.62-48.79)	26.59 (51.72-130.53)	0.006
Lymphocyte/CRP ratio	0.130 (0.68-2.18)	0.027 (0.07-0.54)	<0.001
Hospitalization	2.0 (2.54-4.24)	4.0 (3.18-5.52)	0.005
Mortality	8 (8.4%)	9 (24.8%)	0.014

ASA: American Society of Anesthesiology, CRP: C-reactive protein, LDH: Lactate dehydrogenase, USG: Ultrasonography, CT: Computed tomography

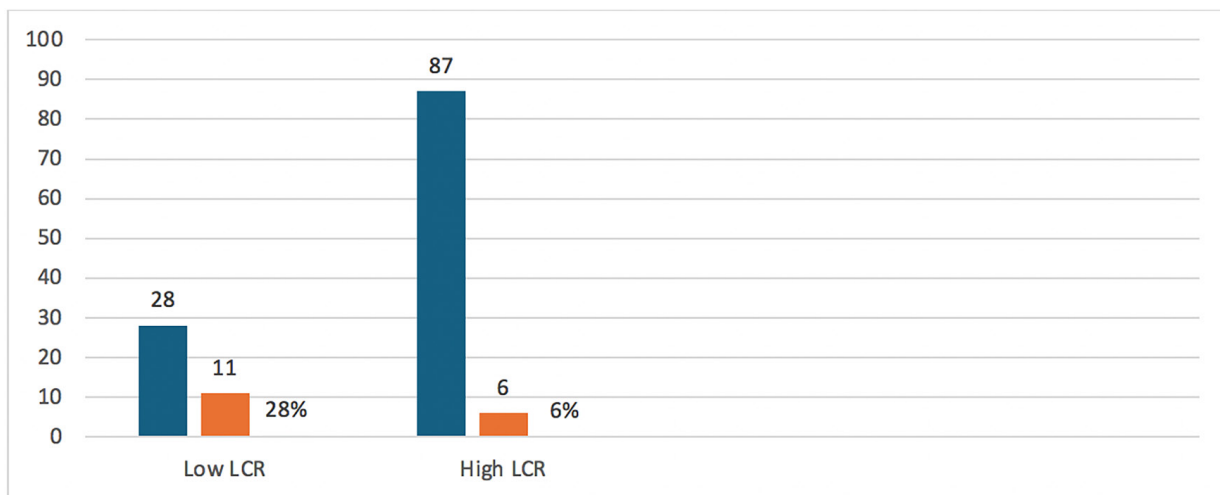


Figure 3. LCR groups and mortality

LCR: Lymphocyte/C-reactive protein ratio

Table 3. LCR groups and ischemia rates

Parameter	Ischemia negative	Ischemia positive
Low LCR	18 (46.2%)	21 (53.8%)
High LCR	77 (82.8%)	16 (17.2%)

LCR: Lymphocyte/C-reactive protein ratio

resection to manage AIH, in line with existing literature. Specifically, the LCR was shown to be a valuable predictive marker, which is clinically helpful for diagnosis. Eyvaz et al.⁽¹⁰⁾ evaluated 129 patients who underwent surgery for acute incarcerated inguinal hernia. They divided the patients into two groups -resection and non-resection- based on the presence of intestinal necrosis, and compared biochemical markers for diagnosing necrosis. In their study, cut-off values for NLR, LCR, and NCR were determined, and all were found to be significant in indicating ischemia. Their results showed that patients with NCR <0.45 (sensitivity: 93.3%, specificity: 87.8%) and LCR <0.1 (sensitivity: 90%, specificity: 78.8%) had an increased risk of ischemia and a higher likelihood of requiring resection, consistent with our findings⁽¹⁰⁾.

In our study, female sex was found to be statistically significant in the resection group in relation to (specific outcome). A meta-analysis by Chen et al.⁽¹¹⁾, which examined risk factors for bowel resection in incarcerated inguinal hernias, reported that female sex and age (>65) were significant risk factors for resection, in addition to inflammatory parameters. Our findings align with the literature in this regard, although no

statistically significant difference was observed between the two groups in terms of age.

Similarly, a study by Kulah et al.⁽¹²⁾ evaluating 385 patients who underwent surgery for AIH found that the risk of strangulation was significantly higher in female patients, those with femoral and umbilical hernias, and elderly patients. The study highlighted these factors as important risk indicators for strangulation⁽¹²⁾. A similar study conducted by Alvarez-Pérez et al.⁽¹³⁾ in Spain observed strangulation in 43.5% of 230 patients, with bowel resection performed in 13.5% of these cases. The study also found that the resection rate was higher among patients with comorbidities, patients over 60 years old, women, and those with femoral hernias.

In a prospective study by Sneiders et al.⁽¹⁴⁾, which included 4472 patients, risk factors for incarcerated primary and incisional ventral hernias were evaluated. The study found that female sex and the presence of severe comorbidities (ASA 3-4) were associated with an increased risk of incarceration, with the most significant risk factor being the width of the defect (3-4 cm)⁽¹⁴⁾. In our study, there was a statistically significant difference in ASA scores between the resection and non-resection groups, and our results are consistent with the literature in this regard. However, hernia size data were not available in our study, which represents a limitation.

In the meta-analysis conducted by Emile et al.⁽¹⁵⁾ on biochemical parameters used to identify intestinal necrosis in acute mesenteric ischemia, several studies indicated

that predictors such as white blood cell, NLR, and platelet-lymphocyte ratio were useful in detecting ischemia and necrosis. Although the LCR value was not included in the studies reviewed in this meta-analysis, the findings support the use of biochemical parameters for detecting ischemia.

The presence of ischemia in incarcerated hernias is the most significant factor contributing to increased mortality and morbidity. Early detection or prediction of ischemia plays a crucial role in reducing these risks. In their study on incarcerated inguinal hernias, Zhou et al.⁽¹⁶⁾ highlighted the relationship between ischemia and mortality. They also developed a predictive model and emphasized the importance of identifying key predictive factors. In our study, although hernia type varied, factors such as gender, ASA score, lymphocyte count, CRP level, and the LCR showed statistically significant differences between the resection and non-resection groups. LCR was evaluated as a predictive parameter.

In their study, Yildirim et al.⁽¹⁷⁾ evaluated patients who underwent surgery for strangulated anterior abdominal wall hernias and compared outcomes of patients with and without bowel resection. The study identified neutrophilia, lymphopenia, and elevated CRP as significant biochemical parameters in the resection group. Subsequently, the LCR and NLR were assessed. The study found that an LCR<0.0204 was a significant biomarker for diagnosing strangulation, with 80% sensitivity and 80.2% specificity⁽¹⁷⁾.

Although various parameters are used as markers of ischemia in the literature, the LCR has been found to be a significant marker in the studies by Yildirim et al.⁽¹⁷⁾ and Eyvaz et al.⁽¹⁰⁾. While Yildirim et al.⁽¹⁷⁾ evaluated incarcerated inguinal hernias, Eyvaz et al.⁽¹⁰⁾ focused on incarcerated incisional hernias. In our study, we evaluated all types of hernias- incisional, umbilical, inguinal, and femoral -and found that LCR was a valuable predictive marker, clinically helpful, and supportive of the diagnosis. Our results are consistent with the existing literature in this regard.

Alhambra-Rodriguez de Guzmán et al.⁽¹⁸⁾ reported that early hospital admission, rapid preoperative evaluation, and timely emergency surgery led to a significant reduction in morbidity and mortality. Therefore, the early detection or prediction of ischemia is crucial for minimizing complications.

Study Limitations

This study has several limitations. First, it is a retrospective design, which inherently carries the risk of bias due to reliance on existing medical records, potentially overlooking unrecorded variables. The sample size of 132 patients may be too small to generalize the results to a broader population, and the single-center nature of the study limits its external applicability. Additionally, the absence of hernia size data, a key factor influencing incarceration and strangulation risk, hinders the full understanding of its role in predicting resection and ischemia. The exclusion of non-surgical patients who underwent successful reduction may introduce selection bias, while the short follow-up period limits insight into long-term outcomes. Confounding factors, such as comorbidities and medication use, were not fully accounted for, and measurement bias in laboratory parameters could affect the consistency of the findings. These limitations suggest the need for further research to address these gaps and confirm the generalizability of the results.

Conclusion

As a conclusion; we demonstrated that the likelihood of resection decreased as the LCR increased in acute incarcerated abdominal wall hernias in our study. LCR can be used alongside other parameters as a simple, effective, and low-cost biomarker to predict ischemia in incarcerated hernias.

Ethics

Ethics Committee Approval: Our study was evaluated by Ege University Medical Research Ethics Committee and approved (decision no: 24-8T/41, date: 22.08.2024).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: T.G., Y.T., B.G., Concept: T.G., E.K., M.S.E., Design: T.G., E.K., M.S.E., Data Collection or Processing: R.T., S.T., Analysis or Interpretation: R.T., Y.T., Literature Search: E.K., B.G., Writing: T.G., R.T.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Townsend CM, Beauchamp RD, Evers BM, Mattox KL. Sabiston textbook of surgery. 20th ed. Philadelphia: Elsevier; 2016.
2. Picart J, Hallway A, Schoel L, et al. Operative decision-making for repair of emergent primary and recurrent ventral hernia. *J Gastrointest Surg.* 202;29:102053.
3. Kandemir H, Donmez T, Surek A, et al. Risk factors for incarceration in groin hernia: a prospective observational study. *Hernia.* 2025;29:142.
4. Pawlak M, East B, de Beaux AC. Algorithm for management of an incarcerated inguinal hernia in the emergency settings with manual reduction. Taxis, the technique and its safety. *Hernia.* 2021;25:1253-8.
5. Gallegos NC, Dawson J, Jarvis M, Hobsley M. Risk of strangulation in groin hernias. *Br J Surg.* 1991;78:1171-3.
6. Nilsson H, Stylianidis G, Haapamäki M, Nilsson E, Nordin P. Mortality after groin hernia surgery. *Ann Surg.* 2007;245:656-60.
7. Li X, Chen Y, Yuan Q, et al. Neutrophil-to-lymphocyte ratio, monocyte-to-lymphocyte ratio, platelet-to-lymphocyte ratio associated with 28-day all-cause mortality in septic patients with coronary artery disease: a retrospective analysis of MIMIC-IV database. *BMC Infect Dis.* 2024;24:749.
8. Hwang SY, Shin TG, Jo IJ, et al. Neutrophil-to-lymphocyte ratio as a prognostic marker in critically-ill septic patients. *Am J Emerg Med.* 2017;35:234-9.
9. Okugawa Y, Toiyama Y, Yamamoto A, et al. Lymphocyte-to-C-reactive protein ratio and score are clinically feasible nutrition inflammation markers of outcome in patients with gastric cancer. *Clin Nutr.* 2019; 39:1209-17.
10. Eyvaz K, Dincer OI, Kazan MK, et al. Neutrophil to C-reactive protein ratio: an estimating factor for intestinal ischemia before the surgery of incarcerated inguinal hernia. *North Clin Istanbul.* 2021;8:575-80.
11. Chen P, Huang L, Yang W, et al. Risk factors for bowel resection among patients with incarcerated groin hernias: a meta-analysis. *Am J Emerg Med.* 2020;38:376-83.
12. Kulah B, Kulacoglu IH, Oruc MT, et al. Presentation and outcome of incarcerated external hernias in adults. *Am J Surg.* 2001;181:101-4.
13. Alvarez-Pérez JA, Baldonado-Cernuda RF, García-Bear I, et al. Presentation and outcome of incarcerated external hernias in adults. *Cir Esp.* 2005;77:40-5.
14. Sneiders D, Yurtkap Y, Kroese LF, et al. Risk factors for incarceration in patients with primary abdominal wall and incisional hernias: a prospective study in 4472 patients. *World J Surg.* 2019;43:1906-13.
15. Emile SH, Khan SM, Barsoum SH. Predictors of bowel necrosis in patients with acute mesenteric ischemia: systematic review and meta-analysis. *Updates Surg.* 2021;73:47-57.
16. Zhou Z, Li Y, Li B, et al. Construction and validation of a predictive model for the risk of bowel resection in adults with incarcerated groin hernia. *BMC Surg.* 2023;23:375.
17. Yildirim M, Dasiran F, Angin YS, Okan I. Lymphocyte-C-reactive protein ratio: a putative predictive factor for intestinal ischemia in strangulated abdominal wall hernias. *Hernia.* 2021;25:733-9.
18. Alhambra-Rodríguez de Guzmán C, Picazo-Yeste J, Tenías-Burillo JM, Moreno-Sanz C. Improved outcomes of incarcerated femoral hernia: a multivariate analysis of predictive factors of bowel ischemia and potential impact on postoperative complications. *Am J Surg.* 2013;205:188-93.